

PERFORMANCE-BASED MEASUREMENTS**TABLE OF CONTENTS**

1.	Background and Rationale	1
2.	Equipment and Supplies	2
2.1	Use of the Stopwatch.....	2
3.	Safety Issues and Exclusions	2
4.	Participant and Exam Room Preparations.....	3
5.	Detailed Measurement Procedures.....	4
5.1	Approach to Standardization.....	4
5.1.1	Instructions and Encouragement	4
5.1.2	Demonstration	4
5.1.3	Practice Trial	4
5.1.4	Rest	4
5.2	General Scoring Issues	5
5.2.1	Not Attempted/Refused.....	5
5.2.2	Unable	5
5.2.3	Valid Yet Unusual Data.....	5
5.3	Introductory Script and Exclusions for Performance Tests	5
5.4	Record Impairments/Appliances	5
5.5	Single Chair Stand: Administration.....	6
5.6	Repeated Chair Stands: Administration.....	8
5.7	Standing Balance: Administration.....	9
	1) Introduction.....	9
	2) Semi-tandem Stand.....	10
	3) Tandem Stand	11
	4) One Leg Stand.....	12
5.8	Six Meter Usual Pace and Balance Walk: Administration	13
	1) Introduction.....	14
	2) Usual Pace Walk	14
	3) 20 cm Narrow Walk.....	15
6.	Procedures for Performing the Measurement at Home	15
7.	Alert Values/Follow-up/Reporting to Participants.....	15
8.	Quality Assurance	16
8.1	Training and Certification	16
8.2	Certification Requirements.....	16
8.3	Quality Assurance Checklist	16
9.	References	18

1. Background and Rationale

Direct assessments of physical performance have become standard measurements in epidemiological studies in the elderly. These assessments generally tap multiple domains of physiological performance, including lower extremity strength, balance, coordination, and flexibility. The assessment techniques used in Health ABC have been

derived from several previous studies, are reliable when performed in a standardized fashion, and are well tolerated by elderly participants. The following assessments are included in the Health ABC performance battery: single and multiple chair stands, standing balance, and short walk tests with narrowed base of support.

2. Equipment and Supplies

- Digital stopwatch (repeated chair stands, standing balance, short walk test)
- Standard chair: straight back, flat, level, firm seat; seat height 45 cm at front (single and repeated chair stands).
- Walking course (See drawing included in description of balance walk)

2.1 Use of the Stopwatch



The stopwatch will be used to measure the time it takes to complete a task from the beginning of the activity until the conclusion. Press the middle (mode) button to make sure you are in stopwatch mode. The display should read **0:00.00**. To time the task, just press the right-hand button (labeled STA/STP) at the top of the stopwatch to begin, and press again when the task is completed. The time is digitally displayed on the stopwatch. To get the display to read **0:00.00** again, press the left (lap) button.

3. Safety Issues and Exclusions

Walking aids may not be used in the chair stand and standing balance tests. The vast majority of participants should be able to attempt the performance tests. Exclusion from the performance tests will be based on an individualized assessment of impairments and safety concerns. The examiner will describe each test, and then discuss with the

participant whether they should attempt that test given any physical problems or disabilities present. Refusal, or inability to perform a test will be recorded on the data form.

Obstructions in the exam area that could cause accidents should be removed. The detailed protocols describe how to administer the tests safely, including instructions on how to support the participant if required. For all test items where loss of balance is a possibility, you should use the following safety precautions. Position yourself standing at the participant's side, slightly behind them. Your hands should be positioned very close to either side of the participant's trunk at the hip or waist level but not touching the participant. Be ready to place both hands on the participant to stabilize them if necessary. If the participant loses balance, immediately hold onto the participant with both hands at the trunk and stabilize them. If the participant begins to fall do not try to catch them; reach under the participant's shoulders from behind and slowly ease them down to the floor. This will protect the participant and examiner from injury.

If the participant falls and is not injured, help them up by first having the participant get on their knees or on all fours, place a chair next to the participant, and have the participant support themselves on the chair as you help lift under the shoulders. Do not try to lift the participant from the floor by yourself.

4. Participant and Exam Room Preparations

- Footwear: To eliminate the effect of different footwear on test performance, these tests should be performed in tennis shoes or comfortable walking shoes with minimal or no heels. The participant may perform the tests in stocking or bare feet if appropriate footwear is not available. Clinics may want to purchase a few sizes of inexpensive tennis shoes to have available.
- The standard chair should be placed on a nonslip surface (low pile carpeting works well) with the back of the chair against a wall for stability. There should be adequate room in front and on the sides of the chair for the examiner and the participant to maneuver freely.
- The standing balance test may be performed with the participant standing about a little less than an arm's length from a wall which will provide an additional source of support if there is a loss of balance.
- Walking course layout: The walk will be conducted on a six meter path in a corridor at least 122 cm wide, without obstructions or irregularities in the floor. The start and finish lines will be marked by tape on the floor. The narrowed path will be marked at 20 cm, using tape. (See figure on page 13)

5. Detailed Measurement Procedures

5.1 Approach to Standardization

The Performance Based Measurements are administered by a certified examiner. Since motivation and level of understanding can have large impacts on performance, each component of the exam should be administered strictly according to the protocol and in the following sequence:

- Explain the procedure to the study participant making sure that key points from the suggested script are conveyed.
- Demonstrate the procedure using suggested script.
- Ask the participant if they have any questions.
- Re-explain the procedure briefly using suggested script.
- Ask the participant to perform the procedure.
- Begin all timed procedures with the words, "Ready? Go!"

5.1.1 Instructions and encouragement: Use the script provided to make sure that all key points are covered when you describe the test and how to perform it properly. You should not provide additional description or encouragement beyond the key points provided by the standard scripts.

If a participant questions the need for detailed verbal instruction, respond that you explain each test in detail since this is the best way to make sure that everyone does the test in a similar manner.

5.1.2 Demonstration: Demonstrate each maneuver for the participant. Remind the participant not to begin to do the maneuver until after you have demonstrated it.

It is very important that the examiner demonstrate each exercise correctly. Experience has shown that participants follow more closely what the examiner does rather than what they say. If the position or exercise is demonstrated incorrectly, the participant following the example will do the exercise incorrectly and be scored as "Unable" even though they may actually have been able to perform it correctly.

If the participant indicates that they do not understand the exercise, demonstrate it again rather than relying on repeated verbal instructions. Repeat the demonstration only once. If the participant still does not understand, go on to the next component of the test.

5.1.3 Practice trial: Practice trials for each test should be limited to those described in the individual measurement procedures.

5.1.4 Rest: The participant should be allowed to rest between tasks if out of breath or fatigued during the assessments.

5.2 General Scoring Issues

5.2.1 Not attempted/refused: If a test is not attempted because the participant refuses or the examiner deems the test unsafe for the participant, for whatever reason, record “not attempted/refused” on the scoring form. Where indicated, record a reason for the refusal.

5.2.2 Unable: If a test is attempted but cannot be completed or scored, record “unable” on the scoring form. Again, where indicated, record a reason.

5.2.3 Valid yet unusual data: If the participant scores valid yet “unusual” (high or low) values, please write a brief explanation where indicated. For example, if there were any possible equipment problems that may have affected the score, please record them.

5.3 Introductory Script and Exclusions for Performance Tests

The participant should be encouraged to perform each test if possible. However, they should also be instructed not to attempt a test if they feel it would be unsafe.

Script: “I’m going to ask you to try to do several different movements of your body. I will first describe and show each movement to you. Then I’d like you to try to do it. If you cannot do a particular movement or you feel it would be unsafe to try to do it, tell me and we’ll move on to the next one. Let me emphasize that I would like you to try each exercise. But I don’t want you to try to do any exercise that you feel might be unsafe.”

Screen for health status:

Script: “Do you have any problems from recent surgery, injury, or other health conditions that might prevent you from standing up from a chair, standing on one leg, or walking?”

If the answer is “yes,” record on the form. Tell the participant who says “yes” that after you describe each test to them, you will discuss whether they should attempt the test given their physical problems. If no problems are mentioned by the participant, mark “no apparent restriction.”

5.4 Record Impairments/Appliances

Identify and record the following:

1) Participant use of a lower extremity orthosis

Orthosis - an orthopedic appliance or apparatus used to support, align, prevent or correct deformities or to improve the function of moveable parts of the body. In this exam we are specifically checking for lower extremity orthoses; plastic or metal leg braces at or above the ankle.

- This refers to the participant's current use of such an aid. They will be wearing the device at the clinic for the exam. An orthosis used at other times (at night, for instance) is not recorded here.
- An orthosis worn below the ankle (for example, a device worn in the shoes for fallen arches) does not qualify in this definition. If you cannot determine whether the participant uses an orthosis ask them.

2) Missing limb

- Major limbs only are considered here: arms (including hands) and legs (including feet). A missing finger or other digit does not constitute a missing limb. A limb is considered missing whether or not an artificial limb is replacing the natural body part.

3) Participant use of a prosthesis

Prosthesis - an artificial substitute for a missing body part, such as an arm or leg, used for functional or cosmetic purposes, or both.

- If the participant is missing a limb, the use of an artificial limb or prosthesis is to be recorded here. This refers to the participant's current use of such an aid. They will be wearing the device at the clinic for the exam. If the participant has mentioned owning a prosthesis but is not currently wearing it, it is not to be recorded here. If you cannot determine whether the participant is wearing a prosthesis ask them.

NOTE: Use of appliances or missing limbs are not exclusion criteria for these tests.

4) Paralysis of an extremity or side of body.

If the participant is unable or has difficulty moving an arm and/or leg due to weakness or spasticity, record this here. Only obvious impairment need be recorded. the examiner is not expected to elicit subtle neurologic signs.

5.5 Single Chair Stand: Administration

This is a test of ability to stand up from a standard chair without using arms. This task is also used to screen for the ability to do repeated chair stands. Walking aids such as canes, walker, or crutches may not be used.

1) A straight-backed chair without arms, with seat height of 45 cm, should be used for this test and placed against a wall for added stability. The participant's feet should be placed squarely on the floor in front of them. The participant should be seated in a position which allows them to place their feet on the floor with knees flexed to slightly greater than 90° so that their heels are somewhat closer to the chair than the back of the knees.

During the test, the examiner may stand in front of the participant (with arms extended, if appropriate) for the participant's safety during the chair stands.

2) Describe the test.

Script: "This is a test of strength in your legs in which you stand up from sitting without using your arms."

3) Demonstrate the procedure.

Script: "Fold your arms across your chest, like this, and stand, keeping your arms in this position. Do you understand?"

4) Ask the participant to stand.

Script: "Ready, Go!"

If the arms unfold, or the participant puts one or both hands down on the chair to push up, remind them to keep their arms folded snugly across their chest and ask them to repeat the chair stand.

It is OK for the participant to move part-way forward in the chair before standing, but knees and hips should be flexed to approximately 90° before standing.

- 5) If the participant cannot rise without using arms, say.

Script: "OK. Try to stand up using your arms to push off."

- 6) Score as follows:

If the procedure was not performed for safety reasons or refused for other reasons, score "Not attempted/refused."

If participant attempted but was unable to arise even using their arms, score as "unable to stand."

If the participant uses arms to stand up, score as "rises using arms."

If they stood up all the way without using arms, score as "Stands without using arms."
Go on to Repeated Chair Stands.

5.6 Repeated Chair Stands: Administration

This is a test of lower extremity strength in which the participant stands up from a seated position five times as quickly as possible. The time it takes to stand five times is recorded.

- 1) If the participant can arise from the chair without using arms, attempt the five stands.

Script: "This time, I want you to stand up 5 times as quickly as you can keeping your arms folded across your chest."

- 2) Demonstrate the test.

Cross your arms over your chest and then rise while emphasizing "full standing position", and sit while emphasizing "all the way down."

Script: "First I will show you. When you stand up, come to a full standing position each time, and when you sit down, sit all the way down each time. I will demonstrate two chair stands to show you how it is done."

Rise two times as quickly as you can, counting as you sit down each time.

3) Begin the test

Script: "When I say 'Go' stand five times in a row, as quickly as you can, without stopping. Stand up all the way, and sit all the way down each time."

Ready, Go!"

Start timing as soon as the examiner says "Go." Count: "1, 2, 3, 4, 5" as the participant sits down each time.

4) If the participant is unable to complete the chair stands correctly (e.g. is not coming to a full stand), abort the procedure, repeat the demonstration, wait 1 minute, and begin the procedure again.

5) If the participant stops before completing five stands, confirm that they cannot continue by asking:

Optional script: "Can you continue?"

If they say yes, continue timing. Otherwise, stop the stopwatch.

6) Score as follows:

If the procedure was not performed for safety reasons or refused for other reasons, score "Not attempted/refused."

If participant attempted but was unable to complete five stands, score as "unable" and record the number completed.

If all five were completed, record:

- the number of seconds, to a hundredth of a second, required to complete five stands

5.7 Standing Balance: Administration

This is a series of timed, progressively more difficult, static balance tests. The level of difficulty increases as the lateral base of support is decreased. The time (up to 30 seconds) the participant can hold each position (semi-tandem, tandem, and one-legged stands) is recorded. Walking aids such as a cane, may not be used in this test.

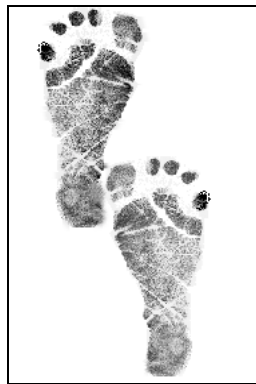
1) Introduction

Script: “I’m going to ask you to stand in several different positions that test your balance. I’ll demonstrate each position and then ask you to try to stand in each position for 30 seconds. I’ll be near you to provide support, and the wall is close enough to prevent you from falling if you lose your balance. Do you have any questions?”

For each stand, describe the position to the participant and then demonstrate it. Demonstrate while facing the participant. After demonstrating, approach the participant from the front and off to the side away from the wall. Offer them your arm (the one away from the wall) for support while they get in position.

If they feel it would be unsafe to try, probe for the reason, and reassure the participant that you will help them into the position and that they will be close to the wall for additional support. If they still feel they should not attempt it, record, “not attempted” for this and the more difficult stands and go on to the next test. Participants who simply feel they cannot do it should be encouraged to try.

If the participant attempts the stand incorrectly, demonstrate it again. Time each stand. After 30 seconds, tell the participant to stop. If the participant loses balance prior to the 30 seconds, record the number of seconds for which the stand was held. See figures for placement of feet for each type of stand.

2) Semi-tandem stand**a) Describe the position.**

Script: “First I would like you to try to stand with the side of the heel of one foot touching the big toe of the other foot for about 30 seconds. Please watch while I demonstrate.”

b) Demonstrate and say:

Script: “You may put either foot in front, whichever is more comfortable. You can use your arms and body to maintain your balance. Try to hold your feet in position until I say stop. If you lose your balance, take a step like this.”

c) Begin the test. Allow the participant to hold onto your arm to get balanced. Say:

Script: “Hold onto my arm while you get in position. When you are ready, let go.”

Start timing when the participant lets go.

(If the participant does not hold onto your arm, start timing when they are in position.

Optional script: “Ready, begin.”)

Stop the stopwatch if they take a step or grab a support.

Record to 0.01 second how long participant is able to hold this position.

Say, “STOP” after 30 seconds.

d) If the participant is unable to hold the semi-tandem stand for at least 1 second, do not attempt the other standing balance tests.

Based on the results from the semi-tandem stand the examiner may also decide it would be unsafe for the participant to proceed to the more difficult positions. Record “not attempted” on the form for the more difficult stands and continue to the next exam.

3) Tandem stand



- a) Describe the position.

Script: “Now I would like you to try to stand with the heel of one foot in front of and touching the toes of the other foot. I’ll demonstrate.

- b) Demonstrate, and say:

Script: “Again, you may use your arms and body to maintain your balance. Try to hold your feet in position until I say stop. If you lose your balance, take a step, like this.”

- c) Begin the test. Allow the participant to hold onto your arm to get balanced. Say:

Script: “Hold onto my arm while you get in position. When you are ready, let go.”

Start timing when the participant lets go.

(If the participant does not hold onto your arm, start timing when they are in position.

Optional script: “Ready, begin.”)

Stop the stopwatch if they take a step or grab a support. Record to 0.01 second how long participant is able to hold this position.

Say, “STOP” after 30 seconds.

- d) If the participant holds the position for 30 seconds, go to the One Leg Stand. Otherwise, perform a second trial of the Tandem Stand.

Script: “Now, let’s do the same thing one more time.”

5) One leg stand

- a) Describe the position.

Script: “For the last position, I would like you to try to stand on one leg for 30 seconds. You may stand on either leg, whichever is more comfortable. I’ll demonstrate.”

- b) Demonstrate the one leg stand by lifting the opposite leg so that the toes are about 2 inches off the floor. The knee should be flexed. While demonstrating say:

Script: “Try to hold your foot up until I say stop. If you lose your balance put your foot down.”

c) Allow the participant to hold onto your arm to get balanced. Say:

Script: “Hold onto my arm while you get in position. When you are ready, let go.”

Start timing when the participant lets go.

Stop the stopwatch if they take a step or grab a support. Record to 0.01 second how long participant is able to hold this position.

Say, “STOP” after 30 seconds.

d) If the participant holds the position for 30 seconds, go to the Balance Walks. Otherwise, perform a second trial of the One Leg Stand.

Script: “Now, let’s do the same thing one more time.”

6) Score as follows:

If the examiner does not allow the participant to attempt a stand, or they refuse, score “refused/not attempted.”

If the participant cannot attain the position at all or cannot hold it for at least one second, score “unable.”

Record to 0.01 second how long participant is able to hold each position..

5.8 Six Meter Usual Pace and Balance Walk: Administration

This is a modification of the short walk test used in many epidemiological and clinical studies. The time to walk 6 m at the participant’s usual pace is measured, along with the number of steps.

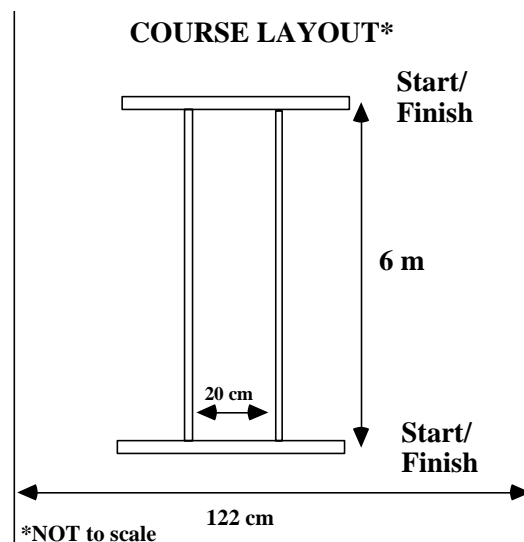
In addition to the standard walk, this test also includes one walk along a narrowed path. The narrowed walk path is designed to make the participant slow down during gait with a narrowed base of support, a situation that requires increased motor control. There will be two scored trials for the narrowed walk.

The 6 m walk tests will be conducted in the following order: usual pace and narrowed to 20 cm.

The 6 m walking course is laid out on the floor as indicated in the figure below. The course must be free of obstacles.

Starting Each Walk Test: The participant should stand with toes just touching the starting line. Hold your arm up, say “Ready, Go,” and then drop your arm. Start timing with the first footfall over the starting line (participant’s foot touches the floor on the first step).

Scoring the Walks: Stop timing with the first footfall (complete or partial) across or touching the finish line. Time is recorded to the nearest 0.01 second. For the usual pace walk, also count all steps. Steps are counted by counting both right and left steps and include the initial starting step and the step that first touches the floor across the finish line.



The narrow path walk is scored for time if there are no more than two deviations from the path. A deviation from the path is defined as stepping on, or going outside of, the colored tape or touching the wall. If there are more than two deviations, the trial is scored as “unable to assess.” Each participant will be given up to three chances to perform the narrowed walk with two or fewer deviations. If they successfully perform the walk in the first two trials, a third trial will not be needed.

1) Introduction

Describe the balance walk.

Script: “This is the balance walk test. First I want you to walk down the hall normally, at a comfortable pace, ignoring the colored lines. For the second walk, I will ask you to walk keeping your feet inside the lines. Each walk will be done at least twice.”

2) Usual pace walk

a) Demonstrate the test: Say the following, while demonstrating where to place the feet and where to walk.

Script: “Place your feet with your toes behind, but touching the starting line. Wait until I say ‘GO.’ Remember, I want you to walk at a comfortable pace ignoring the colored lines.” (Demonstrate and return.) “Walk a few steps past the finish line each time. Any questions.”

b) Hold your arm up. To start the test, drop your arm and say,

Script: “Ready, Go.”

Start timing with the participant’s first footfall. Follow along a few paces behind the participant. Count each step (NOT aloud), both left and right. Hit the start button on the stopwatch as you count the first step. Stop timing with the first footfall touching or across the finish line.

c) Have the participant repeat the usual pace walk.

Script: “OK, fine. Now turn around and when I say go, walk back the other way at a comfortable pace. Ready, GO.”

3) 20 cm narrow walk

a) Explain the 20 cm narrow walk.

Script: “Now for the second walk, I want to keep your feet inside the lines. It is important that you do your best to keep your feet inside the lines.”

b) Demonstrate the walk.

Script: “I’ll demonstrate. Keep your feet inside the lines. Be sure to walk a few steps past the finish line. Any questions?”

c) Begin test. Time as before, but do not count steps. Drop your arm and say,

Script: “Ready, GO.”

d) Record time only if participant’s feet do not deviate from the path more than twice, otherwise score “Unable to assess.” Perform up to three trials to obtain two valid times.

Stays within lines

TRIAL 1 ☐ No* ☐ Yes Ø ____ ____ .__ time (sec)

TRIAL 2 ☐ No* ☐ Yes ____ ____ .__ time (sec)
 Ø

TRIAL 3 ☐ No* ☐ Yes ____ ____ .__ time (sec)
 Ø

***unable to assess time**

6. Procedures for Performing the Measurement at Home

The chair stand and standing balance tests can be performed at home. Procedures to be developed.

7. Alert Values/Follow-up/Reporting to Participants

These test results have no alert values and are not reported to the participant or physician.

8. Quality Assurance

8.1 Training and Certification

The examiner requires no special qualifications or experience to perform this assessment. Training should include:

- Read and study manual
- Attend Health ABC training session on techniques (or observe administration by experienced examiner)
- Practice on other staff or volunteers
- Discuss problems and questions with local expert or QC officer

8.2 Certification Requirements

- Complete training requirements
- Recite exclusions
- Conduct exam on 2 volunteers:
 - According to protocol, as demonstrated by completed QC checklist
 - Times within ± 1 s of QC officer, step counts agrees with QC officer
 - Assessment of “deviations” on narrow walk agrees with QC officer

8.3 Quality Assurance Checklist

- ☐ Performance tests
 - ☐ Asks participant about problems which might prevent testing
 - ☐ Correctly assesses impairments/appliances (records lower-extremity orthosis, prosthesis, missing limb, or paralysis, if present)

Chair stands

- ☐ Back of chair against a wall
- ☐ Script correctly and clearly delivered for each test
- ☐ Correctly demonstrates single stand, emphasizing
 - keeping arms tight across chest
- ☐ Correctly demonstrates two stands, emphasizing
 - full stand and return to complete sit
- ☐ Says “ready, go.” for each test
- ☐ Counts each chair stand, and stops timing after participant sits down on fifth stand
- ☐ Records and explains unusual values
- ☐ If task was not performed, codes and explains reasons

Standing balance

Semi-tandem stand

- ☐ Script correctly and clearly delivered
- ☐ Correctly demonstrates position
- ☐ Timing started coincident with participant release and stopped when participant takes a step or holds on
- ☐ If task was not performed, codes/records reasons

Tandem stand

- ☐ Script correctly and clearly delivered
- ☐ Correctly demonstrates position
- ☐ Timing started coincident with participant release and stopped when participant takes a step or holds on
- ☐ If task was not performed, codes/records reasons
- ☐ Repeat (second trial)

One-leg stand

- ☐ Script correctly and clearly delivered
- ☐ Correctly demonstrates position
- ☐ Timing started coincident with participant release and stopped when participant takes a step or holds on
- ☐ If task was not performed, codes/records reasons
- ☐ Repeat (second trial)

Short walksUsual pace

- ☐ Script correctly and clearly delivered
- ☐ Correctly demonstrates
- ☐ Toes touching start line
- ☐ Timing started coincident with participant's first footfall
- ☐ Correct number of steps counted, and time stopped with first footfall over the finish line
- ☐ Repeat (second trial)

Narrow short walk

- ☐ Script correctly and clearly delivered
- ☐ Correctly demonstrates
- ☐ Toes touching start line
- ☐ Timing started coincident with participant's first footfall
- ☐ Timing stopped at with first footfall over the finish line
- ☐ Ability to stay "in bounds" on narrowed walk correctly assessed
- ☐ Correct number of trials allowed

9. References

1. Ferrucci, Luigi: Unpublished data.

10. Forms